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### CVS covid-19 screening website: Test Automation

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School of Professional Studies

Case Study

CVS covid-19 screening website:  
Test Automation

Author: Savya Rawat

Advisor: Richard Aroian

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## Section 1: Method

CVS Pharmacy is an American retail corporation, also known as, and originally named, the Consumer Value Store owned by CVS Health, it is headquartered in Woonsocket, Rhode Island. CVS Pharmacy is currently the largest pharmacy chain in the United States by number of locations over 9,600 and total prescription revenue. CVS sells prescription drugs and a wide assortment of general merchandise, including over-the-counter drugs.

Now, coming to the reason why I have selected CVS pharmacy's website cvs.com as my case study topic is because of CVS's response to the covid-19 pandemic's no-cost testing strategy. Whole of the world is suffering from covid-19 pandemic, and the United States is one of the countries with highest number of covid-19 cases. The United States has had about a quarter of the global total in reported covid-19 cases and deaths. As there is no vaccine yet, the only solution at present is to stop the spread of the virus from one person to another and to accomplish this, the need of the hour is to test more and test often. CVS being in healthcare domain came up with no-cost onsite and pharmacy covid-19 testing. In addition to onsite and pharmacy testing, CVS also offers symptom screenings, flu vaccines and other immunizations and add-on services like contact tracing for employees exposed to the virus.

### COVID-19 testing

Appointments are available 7 days a week.

**More than 3,800 testing locations. No cost to you.<sup>2</sup>**

**\$0** out-of-pocket cost with insurance or federal program for uninsured<sup>2</sup>

**Lab testing**  
Results typically take 2-3 days.<sup>3</sup>

**Rapid-result testing**  
Get results the same day.<sup>4</sup>  
Availability is limited.

**Get tested**

Tests are limited to eligible individuals in select states. Tests vary by location.

**Where do you live?**

ZIP code, or city and state

**Schedule a test**

Is your employer or university sponsoring a CVS testing program and paying for your test? [Schedule now.](#)

Like many others, even I went for my covid-19 test at cvs pharmacy and I was impressed with their website's features for booking a test and also the way they reflected the test results with least amount of time expected and required. This intrigued my interest on how cvs came up with this add-on feature in their website so quickly. Experiencing it first-hand, also made me realize how effective and user friendly covid-19 screening feature is on cvs pharmacy's website.

CVS pharmacy planned to integrate covid-19 testing and useful resources on their existing website cvs.com. With the need for faster delivery and keep up the quality for the product, getting faster feedback through automated testing comes as a relief for validation during various phases of a software project. This allows for the testing to be carried out repeatedly, delivering faster results each time with lesser effort and time. Testing takes up a significant portion of the overall application development lifecycle. In a situation where we need to deliver fast and more frequently, we can't take risk with any loopholes in testing of final product to be delivered. The same time we can't devote too much of time as well in one activity of our project life cycle. This goes to show that even the slightest improvement of the overall efficiency can make an enormous difference to the overall timeframe of the project. Although the setup time takes longer initially, automated tests eventually take up significantly lesser amounts of time. They can be run virtually unattended, leaving the results to be monitored towards the end of the process. Test Automation greatly helps reduce the time-to-market of an application because the earlier a defect is identified, the more cost-effective it is to fix the glitch. This is how CVS pharmacy was able to react so quickly and add feature of covid-19 screening on its website cvs.com. Nobody was prepared for covid-19 pandemic, but with its tech team equipped with faster delivery has proven how effectively CVS can handle such situation and coming up with new feature delivery in their existing website.



## Section 2: Background Information


This case study is targeting two groups of audiences, the first one is the group of people who are going to CVS pharmacy for no-cost covid-19 test by using their website cvs.com, how easily they are able to book an appointment with the ease of sitting at their home and booking an appointment via desktop or their mobiles itself. Once the test has been carried out and samples have been taken, then seeing results on cvs.com in their newly added covid-19 screening section. Not all of the organizations come up with a new feature delivery this fast and not just delivery its fault proof as well. The newly added feature has not left any impact on the existing website. It is being used by millions of people and it never gets hang, which means its capable enough to handle unexpected large amount of load as well, proving how effectively CVS has delivered a new utmost urgent feature within shortest span of time to its customers.


The second group of audience is the group of tech people who are interested in knowing how these days organizations are delivering fast and more frequently and how testing is carried out so effectively in such scenarios. In today's era if an organization needs to stand-out in terms of faster delivery, in order to keep up the pace with high growing and frequently changing requirements of the customers, it need to deliver fast and deliver frequently. But, with this fast-changing requirement environment there comes a responsibility on testing applications the best possible way before releasing them and the testing needs to be carried out faster and more effectively.

As the world is going through covid-19 pandemic, there is a tremendous pressure on many sectors especially the healthcare sector, expectation of developing vaccine in the shortest time span which the world has never seen, conducting as many covid-19 tests as possible at such a massive scale, providing medical care to covid-19 patients with numbers growing two-folds. In all it's a messed-up situation as nobody was prepared for this pandemic and every other sector is also struggling to survive this pandemic. Coming back to CVS pharmacy and its contribution in handling covid-19 situation. As we all are well aware of CVS pharmacy and what all services it provides, in order to tackle the current situation where there is no vaccine, the only solution is to test as many people as we can to stop the spread of covid-19 virus. CVS pharmacy came up with no-cost testing of covid-19 virus, which really helped people living in The United States to get themselves tested.

**No-cost COVID-19 testing options now available at select CVS Pharmacy® stores. Book an appointment →**

myCVS® Store 12-J BROAD STREET SOUTHW... Change Store > Weekly Ad Sign In or Create an Account Store Locator Español

**CVS pharmacy™** Search 

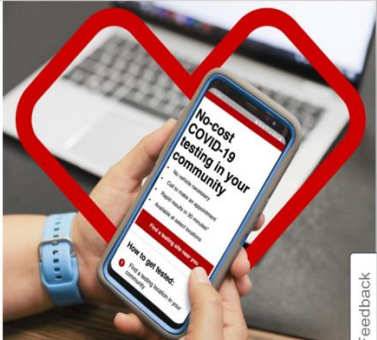
Pharmacy MinuteClinic® HealthHUB Shop ExtraCare® Contact Lenses Photo My Orders ▼  Basket

[Refill Prescriptions >](#) [Shop Online >](#) [Print Photos >](#) [Visit MinuteClinic >](#)

## COVID-19 resources, updates and no-cost testing.

Find no-cost testing options near you. Plus, get answers to your COVID-19 questions and updates on the vaccine's progress.

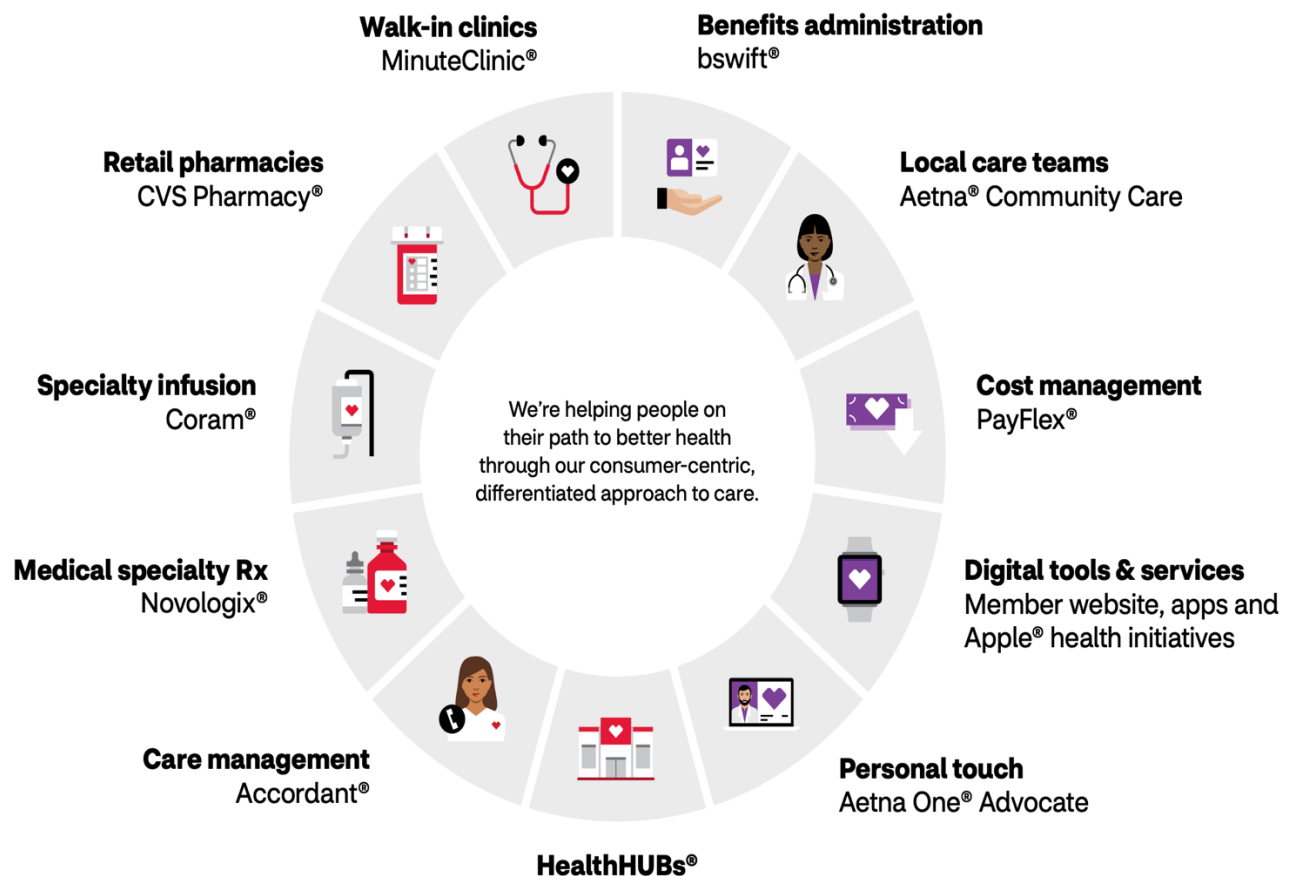
[Schedule a COVID-19 test](#) [COVID-19 resources](#)



CVS pharmacy coming up with the new feature of covid-19 screening website proves how agile they are in their tech development and handling unexpected situations like this. Coming up with new feature developments is really an amendable thing for an organization with such short time span. This proves that they were already following development and especially testing process which were so well equipped to accommodate any new requirements. Testing department is one critical element here as development might finish very quickly for an application with some defects in it but one can do testing while leaving defects unnoticed. Testing of its new website features for covid-19 screening was carried out at such a fast pace and 100% accurate as there are no defects in the websites live performance. In-fact it's able to handle the load of unexpected large load of people navigating for their appointments and their results. The regression testing was handled so effectively with their automation test suites that testing whether the new features are impacting existing functionality or not was tested thoroughly and so far, no complains or anything that sort has been reported by anyone. CVS pharmacy's tech testing department knows very well that testing can determine the product health at any given moment of time and how critical quality assurance gating process is before releasing important and urgent feature especially when we are going through this pandemic and how critical it is for people to get tested for covid-19 virus and the experience for booking a test should be easily available at the ease of their mobile or desktop.

### Section 3: About the Organization

CVS Health is a health care innovation company that is reinventing pharmacy. CVS Health is a one-of-a-kind health care company that helps patients get the care they need through the channel that works best for them. For more than 50 years, CVS Pharmacy has offered customers the products and services they need to stay on their path to better health. In addition to the pharmacies, their stores feature on-trend beauty departments, healthier food options and a selection of general merchandise. At CVS Health, they share a clear purpose: helping people on their path to better health. Through their health services, plans and community pharmacists, they are pioneering a bold new approach to total health. Making quality care more affordable, accessible, simple and seamless, to not only help people get well, but help them stay well in body, mind and spirit. CVS Health's suite of assets includes the following:



#### Facts and figures about CVS Health:



- CVS Pharmacy is the largest retail pharmacy in the U.S. filling more than one billion prescriptions each year. Their retail stores feature thousands of items including organics and naturals, innovations in beauty and health, and healthier-for-you food choices. Their more than 9,900 pharmacies offer innovative care programs that help improve health outcomes and address specific patient needs.
- Approximately 23 Million medical benefit members.
- They have 1,100 MinuteClinic locations with 54 Million patient visits to the MinuteClinic.
- 26 retail specialty pharmacies. CVS Specialty provides specialty pharmacy services for patients who require treatment for rare or complex conditions.
- Patients receive ongoing disease education, counseling and benefits verification, as well as coordination of care with multiple health care providers, comprehensive patient education and adherence management.
- On September 03<sup>rd</sup> 2014, CVS became the first pharmacy retailer to stop selling tobacco.
- Approximately 300k colleagues across all 50 states, Washington, D.C. and Puerto Rico.
- Approximately 68,000+ retail network pharmacies.
- Approximately 62 Million ExtraCare members. As the rewards industry's longest-running loyalty program and the first to be used in drugstores, CVS ExtraCare® Rewards has given members access to exclusive, personalized offers, savings and rewards on nearly everything they buy for more than 20 years.
- Approximately 2.8 Billion prescriptions managed or filled.
- Comes with 75 major health system affiliations.
- Approximately 4.5 Million customers served by CVS pharmacy daily.
- As a leading pharmacy benefit manager aka PBM, they use integrated model to help transform pharmacy care, reduce pharmacy spend for payors and deliver better health outcomes for their members. As of today, they have approximately 103 Million PBM members.
- Across the country, they provide specialized long-term care pharmacy services that include consulting and data management. Around 5 Million patients served by Omnicare annually.
- Coram CVS Specialty Infusion Services delivers high-quality infusion therapy services in home-based and outpatient settings to more than 205,000 patients per year.

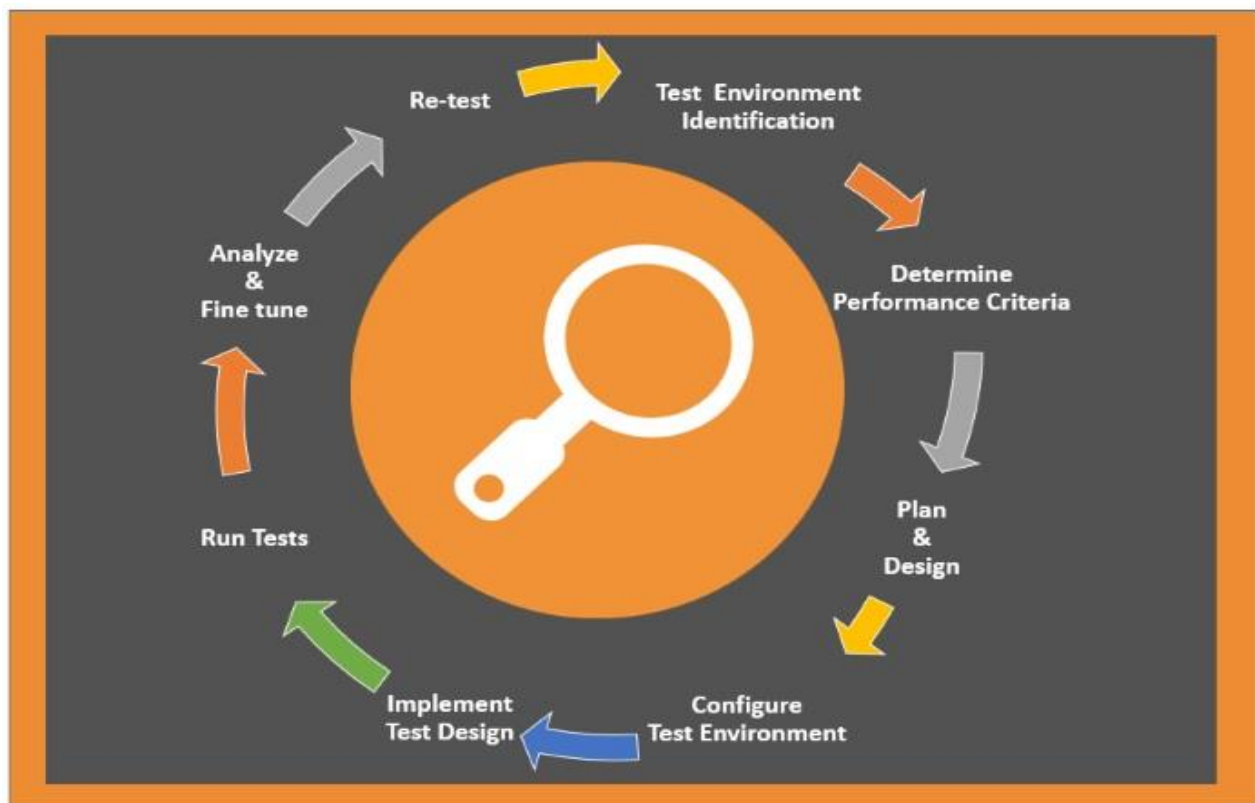
## Section 4: The Challenge

In the past, organizations had a separate QA department that acted as a gatekeeper between development and customers. After development finished integrating their changes into a new build, QA would run it through a gauntlet of tests in a dedicated test environment. This was a discrete and lengthy process that focused mainly on testing application-layer functionality and involved very little communication between testers, developers, and operations teams. Testing was a distinct stage in the software development life cycle (SDLC) that emphasized finding defects, relied heavily on manual testing, and focused primarily on testing the application layer. This process was slow, inflexible, and prone to human error. Modern applications are changing, and traditional testing practices are no longer up to the task. In order to validate the reliability of distributed architectures in DevOps organizations we need a new testing methodology. Quality Assurance team have to validate an ever-increasing number of changes at a faster pace than their existing methods could support. Testing could no longer be a distinct stage in the software development life cycle, but an ongoing process that could be applied at various stages including during development and after releasing to production.

Further complicating this was the migration from monolithic applications to cloud applications and microservices. Where monoliths are relatively static and predictable, microservices are much more dynamic. They can scale to unprecedented levels, can be deployed across multiple regions, and are almost completely abstracted from the underlying infrastructure. This required an entirely new approach to software testing, placing additional pressure on testing teams. Testing practices must adapt to support applications that are much more complex, constantly changing, and require a high level of availability, or risk bringing the entire organization to a grinding halt. Organization like CVS Health, who are not a core tech company, need to rethink their testing methodologies and approaches in order to ensure their applications and infrastructure remain resilient, but without sacrificing speed. With QA acting solely as gatekeeper between development and operations, testing became a bottleneck. This was especially true for QA teams that relied on manually executing test cases instead of using automated testing tools. Organizations would have to leave a significant amount of post-development time open for QA to validate builds, or risk releasing a product with critical defects.

With organizations working on microservices framework model, microservices increased testing complexity as Microservices consist of many independent and interconnected services that interact to form a single cohesive system. Teams can deploy, modify, and scale their services independently of one another, making it much more difficult to track the different ways that failures can occur. Testing needs to account for each individual service as well as the application as a whole. A failure within a single service is bad enough, but if that service is an upstream dependency, that failure can have far-reaching consequences on the entire application. This makes testing microservices as a single unit and as a whole system more frequently and more accurately, manual testing approach in this scenario is not acceptable for its slowness and loads of workload. Need of the hour is to automate test scripts as much as possible with almost zero manual testing intervention. Testers also need to take these emergent behaviors into account when creating and running tests.

***“To maintain a high level of availability at faster velocity, teams must find ways to decrease their failure rate.”***



When it comes to delivering new features in an existing website like cvs.com which has got already so many features, there are so many challenges as follows:

- **Integration:** integration testing can show the different issues an application may have when interacting with other applications, allowing the developer to tweak things. Environment and infrastructure inconsistency, different interaction models, and overall performance are just a few of the issues associated with integration testing.
- **Interoperability:** Proving end-to-end functionality between communicating systems is always a challenging obstacle. Different users utilize different browsers and operating systems. To pull data, testing each one to confirm a clear information pathway is very important.
- **Security:** In one of the most important tests, the developer must make sure that the continually evolving cyber threat can be countered and neutralized. Additionally, tests associated with data integrity before and after an attack are equally important when considering data breaches or lost information. Some of the challenges associated with security testing include dealing with unsecured communications, removing malicious files (if security firewalls have been breached), and the utilization (and integration) of different authentication procedures.
- **Performance:** The speed of the app is defined by the need of the user, and with more users expecting more speed, the requirement of performance is non-negotiable. Testing large applications on minimal hardware, underestimating software requirements, and overextending application features are just a few of the issues associated with performance testing. Integration and interoperability issues can also have a direct effect on performance, and because of that, should be tested at the beginning.
- **Usability:** Since web-based applications are dependent on different browsers, consistent usability is crucial. Additionally, since the app is the brand (or a component thereof), any inconsistency within the user experience may translate into a negative experience, affecting the brand and its potential growth. When testing usability, testers face issues with scalability and interactivity. Since every user is different, it is important for testers to utilize a representative group to test the application across different browsers, using different hardware.
- **Automation:** Testing whole application as part of regression test plays a vital role when it comes to delivering a feature in short span of time, manual testing is time consuming, to check a product's health any given moment of time one needs to keep testing ongoing every time.

## Section 5: The Solution

Traditional software testing focuses on finding and fixing defects at the end of the development cycle. With modern applications, testing requires a much more thorough and proactive approach. To close the reliability gap, test teams must adapt testing practices that address four key pain points which are mentioned as below:

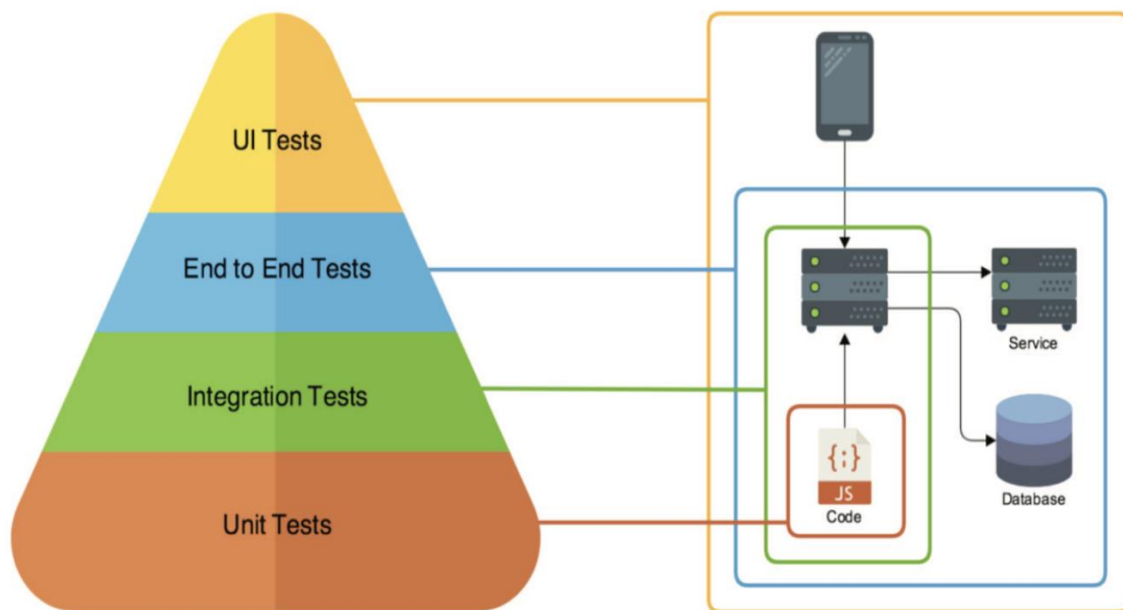
**Testing needs to be a continuous process, not just one stage:** The longer DevOps teams wait to test for defects, the more expensive and time-consuming they are to fix. Testing needs to shift left from after development into earlier DevOps stages so that teams can identify potential problems as early as possible. Testing also needs to shift right to extend testing into production.

**Testing needs to be automated:** Automated testing allows for faster testing cycles, guarantees consistency between test runs, and frees engineers to focus on other tasks. Automated testing fits well into a continuous integration and continuous delivery CI/CD pipeline by providing immediate validation of new changes and notifying developers of failed changes. This provides a significantly faster turnaround rate when compared to manual testing.

**Testing needs to shift right into production:** Most engineering teams are familiar with testing in pre-production environments before deploying to production. However, these environments don't offer a realistic expectation of how applications will behave once they're in production due to fundamental differences in how these environments are designed, configured, and operated. Microservices are even more difficult to replicate in pre-production because of their complex dependencies and interactions. The only way for testers to truly understand how applications will behave in production is by testing them in production.

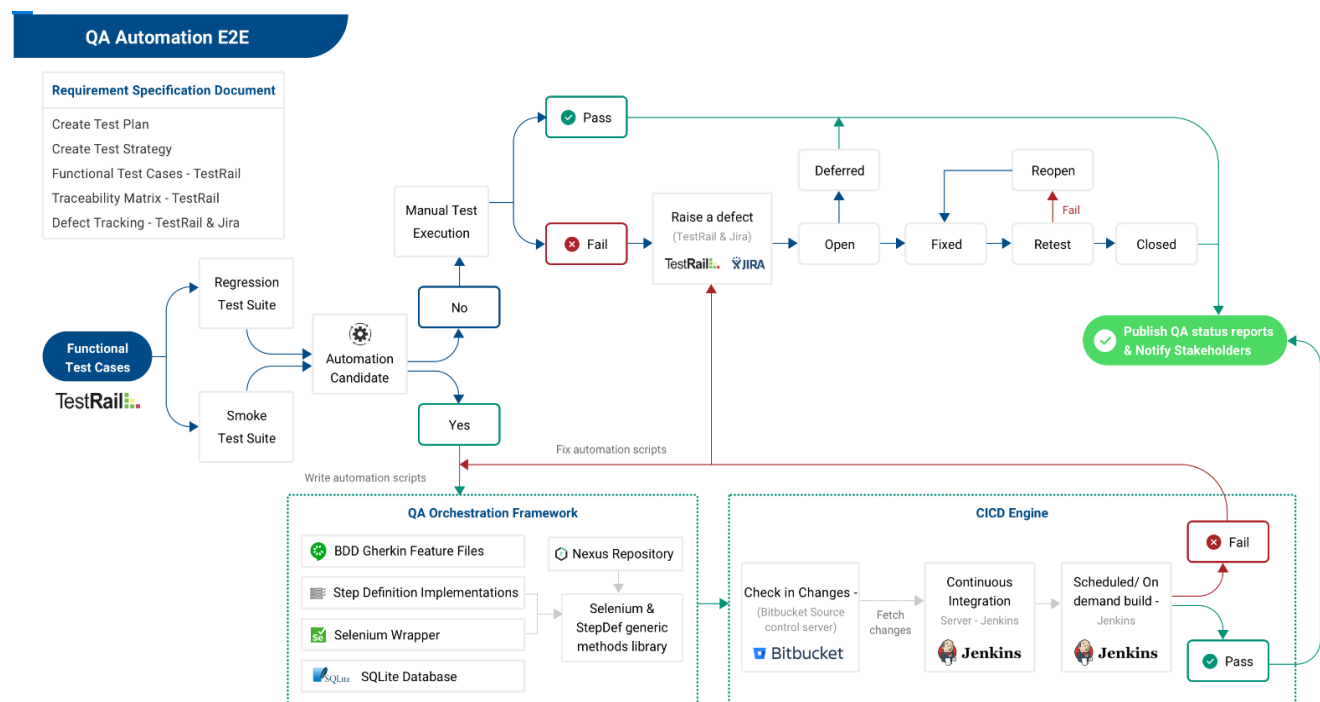
**Testing needs to factor in the unknown:** Modern applications are vastly more complex than traditional applications, and this complexity can cause unpredictable and emergent behaviors. Many testers design tests around happy paths, which are the paths that users are expected to take through an application. This doesn't account for the many ways users can interact with applications in unintended ways, nor the many things that can go wrong on production systems. Testers will need to adopt testing practices that can help identify these unknowns.

In the traditional SDLC, testing was a single-phase following development and preceding release. However, this approach had several faults. Waiting to test until after development reduced the chances of testers finding defects until they were already introduced, resulting in higher costs for the organization. Fixing a defect after release can be up to 30 times as expensive as fixing it in the design stage. In addition, there is an increased risk of testers not identifying these defects before they're released into production. Up to 80% of issues affecting customers can be traced back to the planning and requirements stages of the DevOps cycle, and could have been prevented by introducing testing earlier in the SDLC. By testing continuously and throughout the DevOps cycle, we can reduce the rate and cost of defects by identifying them early and addressing them before they can impact customers.



**Unit tests** verify the behavior of individual code components. **Integration tests** verify that multiple components and services interact as expected. **Functional and end-to-end tests** verify that multiple combined systems integrate successfully in order to meet requirements. **UI tests** verify that customers can successfully interact with our application through the user interfaces provided. The use of **automated CI/CD pipelines** has greatly increased the speed at which DevOps teams integrate, test, and deploy changes. A well-designed CI/CD pipeline can bring a change into production with zero human intervention but accomplishing this requires fully automated testing and automated deployment tools.

QA process at CVS Health is mainly focused on automation to address today's fast-moving changes and requirements at times by the customer or at times urgent and unexpected need in scenarios like covid-19 pandemic. The automation framework is built on tools like Eclipse IDE, Selenium WebDriver, BDD Gherkin Feature Files, SQLite Database. Test management tool used is TestRail, defect management tool used is Jira. The CI/CD pipeline at CVS Health uses automation tools like Jenkins for scheduled and on-demand builds and also for continuous integration. Source code management tool used is Bitbucket. Below mentioned is QA Automation end-to-end diagram of how testing process has been automated at CVS Health:



This framework has helped CVS Health to ensure quality at speed and meet product increment deadlines while keeping bugs out of final product. This has efficiently helped in executing automation scripts as many times as required, quick and stable test runs, minimized test maintenance, more emphasis on quality controlling. Detect Critical Issues in CI/CD Pipelines before they go into production, block the deployment of any branch that will break your product in production. Eventually this has helped CVS to save costs by catching issues earlier on in the development process before bugs escalate in production environment.

## Section 6: Conclusion

The way CVS pharmacy introduced its new feature for covid-19 screening has proved that testing team follows right automation pipeline for its faster and frequent deliveries. These automated CI/CD pipelines are very well integrated with automation test suites which helps in testing unit testing and a system as whole at any given moment of time. Manual testing is time-consuming as for every fix deployed in production, testers have to repeat a set of similar test cases over the same period to ensure that the bug has been removed. Regression testing has been a pain point for every developer. Performing the same test over and over, not only takes more time but also brings down the overall efficiency of a tester. Hence, automation test suites helped in testing cvs.com for every release and hot fixes. While developing a website, it is essential to ensure the cross-browser compatibility over various browsers, hardware, operating systems, networks and mobile devices. Performing browser compatibility testing requires the creation of countless test cases. Especially, considering the number of browsers versions available in the market. Performing manual testing over hundreds of browsers + OS combination may result in delaying the software release process. However, automated testing allowed CVS Health's website cvs.com testers to execute tests on thousands of browsers, operating systems, and devices quickly, and simultaneously.

No doubt that the initial investment for automation framework setup and CI/CD pipelines was on the higher side for CVS testing team, but CVS saved a lot of additional expenses with automation testing with effective resource utilization. Once their automation test scripts were all set then they need minimal hands-on deck to monitor those test case execution on a frequent basis and troubleshoot in case of any script failures. Test automation results in a higher quality of work, reducing the need for fixing glitches after the product is released. Therefore, a reduced business expense is one of the significant benefits of automation testing what CVS Health have gained. One of the major benefits of automation testing over manual is the flexibility to execute testing at any time, from anywhere in the world. For performing manual testing you would need to work your way out through a computer for testing a web application. You can't carry your computer, laptop, everywhere. Also, if somebody asked you to perform a round of testing at 3:00 am in the morning after a long day at work. I am sure you will not find your mood to be very pleasant over the thought. Let alone your comfort. This is why automation testing is better than manual testing, as in such scenarios you could schedule your test case execution to run at any hour of the day, remotely from



any location and analyze the test results by reports generated on the basis of your test suite execution. This flexibility helped the testing team of CVS Health to work from anywhere as in this covid-19 pandemic everybody was working from home only as offices were closed and countries were facing lockdown, in such scenario what else could be more beneficial for an employee to work from the comfort of their homes and trigger the automation test suites for regression testing of the new features required in cvs.com website and helping in automating CI/CD pipelines and helping in faster and more frequent releases.



Manual testing can help to bring quality test case but when we talk about 100% test coverage for a complex web-application. Doing so manually can be very challenging. One of the key benefits of automation testing is that it can help you maximize your test coverage. Automation testing tools can ease the testing by ensuring the in and out of the software such as databases, web services, UI and so on as per the business requirements. It will, in turn, improve overall test coverage of a web application. Hence, to conclude our case study we must adhere to an integrated approach of manual and automated testing with more emphasis on automation as automation testing can help reduce time-to-market and launch a bug-free product, by taking care of repetitive tasks with a smaller number of resources on-board, thereby, maximizing Return on Investment for businesses.

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